

Amendment and Response
 Serial No.: 09/519,448
 Confirmation No.: Unknown
 Filed: 5 March 2000
 For: FLUID HANDLING DEVICES WITH DIAMOND-LIKE FILMS

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Remarks

The Office Action mailed 14 January 2002 has been received and reviewed. Claims 12 and 16 having been cancelled and claims 1, 18, 19, 20, 24, 25, and 26 having been amended, the pending claims are claims 1-11, 13-15, and 17-26. Reconsideration and withdrawal of the rejections are respectfully requested.

The claims have been amended to recite that the diamond-like film includes diamond-like glass that includes a dense random covalent system, and, on a hydrogen-free basis, at least about 30 atomic percent carbon, at least about 25 atomic percent silicon, and less than or equal to about 45 atomic percent oxygen. This is supported by the specification at, for example, page 4, line 25, through page 5, line 5, and page 13, lines 27-32.

Restriction Requirement

The Examiner issued a Restriction Requirement under 35 U.S.C. §121 in the above-identified application, grouping the claims as follows: Group I, Claims 1-25, drawn to a microfluidic article, and Group II, Claim 26 drawn to a method of manufacturing. A provisional election to prosecute claims 1-25, Group I, was made in response to a telephone conversation with the Examiner on 10 January 2002. The provisional election to prosecute Group I is herein affirmed.

Contrary to the Examiner's statement, this election is with traverse. It is respectfully submitted that the method claim can be examined with the article claims without placing undue burden on the Examiner. Thus, Applicants' Representatives request rejoinder.

In the event the Examiner maintains the restriction requirement, rejoinder of the non-elected method claim is respectfully requested upon notice of allowance of any of the elected article claims. Notably, the non-elected method claim recites the same language regarding diamond-like glass as each of the article claims (see 1184 O.G. 86, citing In re Ochiai, 37 USPQ2d 1127 (Fed. Cir. 1995), and In re Brouwer, 37 USPQ2d 1663 (Fed. Cir. 1996)).

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The 35 U.S.C. §112, Second Paragraph, Rejection

The Examiner rejected claims 1-18 under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. Specifically, the claims are vague and indefinite as to what type of structure is intended by "diamond like." This rejection is respectfully traversed.

Herein, the term "diamond-like" is clearly used to distinguish "diamond." See, for example, page 14, line 16, through page 15, line 33, where "diamond" film properties are described relative to "diamond-like" film properties.

Furthermore, the term "diamond-like" is defined at page 4, line 25, through page 5, line 5, wherein a "diamond-like film" is defined as referring to:

... substantially or completely amorphous films including carbon, and optionally including one or more additional components selected from the group of hydrogen, nitrogen, oxygen, fluorine, silicon, sulfur, titanium, and copper. Other elements may be present in certain embodiments. The films may be covalently bonded in a random system or in an interpenetrating system, such as in an interpenetrating diamond-like nanocomposite (called DYLYN), as described, e.g., U.S. Pat No. 5,466,431. The amorphous diamond-like films of this invention may contain clustering of atoms that give it a short-range order but are essentially void of medium and long range ordering that lead to micro or macro crystallinity which can adversely scatter actinic radiation having wavelengths of from 180 nm to 800 nm. The term "amorphous" means a substantially randomly-ordered non-crystalline material having no x-ray diffraction peaks or modest x-ray diffraction peaks. When atomic clustering is present, it typically occurs over dimensions that are small compared to the wavelength of radiation.

This would clearly be understood by one of skill in the art as to the type of structure intended.

Furthermore, the claims have been amended to recite more specifically that the diamond-like film is diamond-like glass. This phrase (diamond-like glass) is also well-defined in the specification. See, for example, page 13, lines 27-32.

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The Prior Art Rejections

The Examiner rejected claims 1-5, 7-8, 10, 12-14, 17-18, and 25 under 35 U.S.C. §102(b) as being anticipated by IBM Technical Disclosure Bulletin (MAGNETOSTRICTIVE MOLECULE SEPARATOR CHROMATOGRAPHY), Yamanoto et al. (U.S. Patent No. 5,788,766), WO 94/21372, or WO 98/21626. These rejections are respectfully traversed.

There is no teaching or suggestion of diamond-like glass a dense random that includes a covalent system, and, on a hydrogen-free basis, at least about 30 atomic percent carbon, at least about 25 atomic percent silicon, and less than or equal to about 45 atomic percent oxygen. Furthermore, there is no teaching or suggestion of diamond-like glass disposed on a surface of a fluid handling device. Thus, the Examiner is respectfully requested to withdraw these rejections.

The Examiner rejected claims 1-25 under 35 U.S.C. §102(b) as being anticipated by EP 0856592, Giglia et al. (U.S. Patent No. 4,698,256), WO 96/40446, WO 97/48836, WO 97/40207, David et al. ("Plasma Deposition and Etching of Diamond-Like Carbon Films, AIChEJ, 37(3): 367-376 (1991)) and Bray et al. ("New Family of Tailorable Thin-Film Coatings," Advanced Materials & Processes, 146, No. 6, pp. 31-34, December 1994). These rejections are respectfully traversed.

There is no teaching or suggestion of diamond-like glass a dense random that includes a covalent system, and, on a hydrogen-free basis, at least about 30 atomic percent carbon, at least about 25 atomic percent silicon, and less than or equal to about 45 atomic percent oxygen. Furthermore, there is no teaching or suggestion of diamond-like glass disposed on a surface of a fluid handling device. Thus, the Examiner is respectfully requested to withdraw these rejections.

The Examiner rejected claims 1-25 under 35 U.S.C. §103(a) as unpatentable over Wilding et al. (U.S. Patent No. 5,637,469), "Sun International Division, Comar Inc., Corporate Capabilities, pg. 110, Company Description, markets served, major products and facilities (undated), or Kopf-Sill et al. (U.S. Patent No. 5,842,787) in view of EP 0856592, Giglia et al.

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(U.S. Patent No. 4,698,256), WO 96/40446, WO 97/48836, WO 97/40207, David et al. ("Plasma Deposition and Etching of Diamond-Like Carbon Films, AIChEJ., 37(3): 367-376 (1991) and Bray et al. ("New Family of Tailorable Thin-Film Coatings," Advanced Materials & Processes, 146, No. 6, pp. 31-34, December 1994). These rejections are respectfully traversed.

There is no teaching or suggestion of diamond-like glass a dense random that includes a covalent system, and, on a hydrogen-free basis, at least about 30 atomic percent carbon, at least about 25 atomic percent silicon, and less than or equal to about 45 atomic percent oxygen. Also, there is no teaching or suggestion of diamond-like glass disposed on a surface of a fluid handling device. Furthermore, there is no teaching or suggestion that diamond-like glass films would be advantageous on fluid handling devices, particularly having the advantages described throughout Applicants' Specification (e.g., the Examples). Thus, the Examiner is respectfully requested to withdraw these rejections.

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Summary

It is respectfully submitted that the pending claims 1-11, 13-15, and 17-26 are in condition for allowance and notification to that effect is respectfully requested. The Examiner is invited to contact Applicants' Representatives, at the below-listed telephone number, if it is believed that prosecution of this application may be assisted thereby.

Respectfully submitted for
Moses M. DAVID et al.

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CERTIFICATE UNDER 37 C.F.R. §1.8: The undersigned hereby certifies that this Facsimile Cover Sheet and the paper(s), as described hereinabove, are being transmitted by facsimile in accordance with 37 CFR §1.6(d) to the Patent and Trademark Office addressed to Assistant Commissioner for Patents, Washington, D.C. 20231, on this 15th day of APRIL, 2002, at 8:30PM (Central Time).

Ann M. Mueting

**APPENDIX A - SPECIFICATION/CLAIM AMENDMENTS
INCLUDING NOTATIONS TO INDICATE CHANGES MADE**
Serial No.: 09/519,448
Docket No.: 55436 USA 6A

Amendments to the following are indicated by underlining what has been added and bracketing what has been deleted. Additionally, all amendments have been marked in bold typeface.

In the Claims

For convenience, all pending claims are shown below.

1. (AMENDED) A fluid handling device comprising a substrate and an optically transmissive diamond-like film disposed on at least a portion of the substrate, wherein the film comprises diamond-like glass comprising a dense random covalent system comprising on a hydrogen-free basis at least about 30 atomic percent carbon, at least about 25 atomic percent silicon, and less than or equal to about 45 atomic percent oxygen.
2. The fluid handling device of claim 1 comprising a capillary having an internal surface and an external surface, wherein at least a portion of at least one of the internal or external surfaces includes an optically transmissive diamond-like film disposed thereon.
3. The fluid handling device of claim 2 wherein the external surface of the capillary includes an optically transmissive diamond-like film disposed on at least a portion thereof.
4. The fluid handling device of claim 1 comprising a microfluidic article comprising a microfluidic handling architecture comprising a fluid handling surface, wherein at least a portion of the fluid handling surface includes an optically transmissive diamond-like film disposed thereon.
5. The fluid handling device of claim 4 wherein the optically transmissive diamond-like film is also hydrophilic.

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Applicant(s): Moscs M. DAVID et al.

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6. The fluid handling device of claim 4 comprising:
 - a first non-elastic, polymeric substrate comprising a first major surface that includes the microfluidic handling architecture and a second major surface; and
 - a second polymeric substrate that is integrally bonded to said second major surface of said first substrate, wherein the second substrate is capable of forming a free-standing substrate in the absence of said first substrate.
7. The fluid handling device of claim 4 comprising a cover layer on the microfluidic handling architecture.
8. The fluid handling device of claim 7 wherein the cover layer is bonded to the first major surface of the first substrate.
9. The fluid handling device of claim 4 wherein the microfluidic handling architecture comprises structures selected from the group consisting of microchannels, fluid reservoirs, sample handling regions, and combinations thereof.
10. The fluid handling device of claim 9 wherein at least one of the structures comprises a fluid handling surface, at least a portion of which has the optically transmissive diamond-like film disposed thereon.
11. The fluid handling device of claim 4 comprising a first polymeric substrate comprising a first major surface that includes a plurality of microfluidic handling architectures and a second major surface, wherein the article is in the form of a roll.
12. CANCELLED

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13. The fluid handling device of claim 1 wherein the optically transmissive diamond-like film has disposed thereon linking agents and a reactant affixed to the linking agents to form a binding site.
14. The fluid handling device of claim 13 wherein the linking agents are covalently attached to the diamond-like film.
15. The fluid handling device of claim 13 wherein the reactant is selected from the group consisting of nucleic acids, proteins, and carbohydrates.
16. CANCELLED
17. The fluid handling device of claim 1 wherein the diamond-like film is also hydrophilic.
18. (AMENDED) A fluid handling device comprising a microfluidic article comprising a microfluidic handling architecture comprising a fluid handling surface wherein at least a portion of the fluid handling surface includes a hydrophilic diamond-like film disposed thereon, wherein the film comprises diamond-like glass comprising a dense random covalent system comprising on a hydrogen-free basis at least about 30 atomic percent carbon, at least about 25 atomic percent silicon, and less than or equal to about 45 atomic percent oxygen.
19. (AMENDED) A fluid handling device comprising a substrate and an optically transmissive and hydrophilic film [comprising at least about 25 atomic percent carbon, from 0 to about 50 atomic percent silicon, and from 0 to about 50 atomic

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percent oxygen, on a hydrogen-free basis,) disposed on at least a portion of the substrate, wherein the film comprises diamond-like glass comprising a dense random covalent system comprising on a hydrogen-free basis at least about 30 atomic percent carbon, at least about 25 atomic percent silicon, and less than or equal to about 45 atomic percent oxygen, and further wherein the film has an extinction coefficient of no greater than 0.010 at 250 nm.

20. (AMENDED) A fluid handling device comprising a substrate and a diamond-like glass film comprising a dense random covalent system comprising at least about 30 atomic percent carbon, at least about 25 atomic percent silicon, and less than about 45 atomic percent oxygen, on a hydrogen-free basis, disposed on at least a portion of the substrate.
21. The fluid handling device of claim 20 comprising a capillary having an internal surface and an external surface, wherein at least a portion of at least one of the internal or external surfaces has the film disposed thereon.
22. The fluid handling device of claim 21 wherein at least a portion of the external surface of the capillary has the film disposed thereon.
23. The fluid handling device of claim 20 comprising a microfluidic article comprising a microfluidic handling architecture including a fluid handling surface wherein at least a portion of the fluid handling surface has the film disposed thereon.
24. (AMENDED) A fluid handling device comprising a microfluidic article comprising a microfluidic handling architecture including a fluid handling surface wherein at least a portion thereof has disposed thereon a film comprising [at least about 25 atomic percent carbon, from 0 to about 50 atomic percent silicon, and from 0 to about 50

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atomic percent oxygen, on a hydrogen-free basis] diamond-like glass which comprises a dense random covalent system comprising on a hydrogen-free basis at least about 30 atomic percent carbon, at least about 25 atomic percent silicon, and less than or equal to about 45 atomic percent oxygen.

25. (AMENDED) A fluid handling device comprising a microfluidic article comprising a microfluidic handling architecture including a non-fluid handling surface wherein at least a portion thereof has disposed thereon a diamond-like film that is optically transmissive, hydrophilic, or both, wherein the film comprises diamond-like glass comprising a dense random covalent system comprising on a hydrogen-free basis at least about 30 atomic percent carbon, at least about 25 atomic percent silicon, and less than or equal to about 45 atomic percent oxygen.
26. (AMENDED) A method of manufacturing a hydrophilic diamond-like film, the method comprising treating a diamond-like film in an oxygen-containing plasma, wherein the film comprises diamond-like glass comprising a dense random covalent system comprising on a hydrogen-free basis at least about 30 atomic percent carbon, at least about 25 atomic percent silicon, and less than or equal to about 45 atomic percent oxygen.